

## WHAT IS CLAIMED IS:

- 1       1. A hydrogen sensor comprising:
  - 2           a) a dielectric surface material; and
  - 3           b) at least one metal nanowire comprising Pd and Ag on said dielectric surface,
  - 4       wherein said metal nanowire comprises at least one nanobreakjunction which closes
  - 5       when exposed to a threshold hydrogen concentration.
- 1       2. The hydrogen sensor of claim 1, further comprising electrodes in contact with
- 2       said metal nanowire.
- 1       3. The hydrogen sensor of claim 2, further comprising a power supply connected to
- 2       said electrodes so as to form a circuit.
- 1       4. The hydrogen sensor of claim 3, further comprising a device for measuring one or
- 2       more electrical properties of said metal nanoparticles within said circuit.
- 1       5. The hydrogen sensor of claim 1, wherein solvation of hydrogen in the metal
- 2       nanowire effects an electrical response at some threshold concentration by closing
- 3       said nanobreakjunctions.
- 1       6. The hydrogen sensor of claim 5, wherein said electrical response is selected from
- 2       the group consisting of a change in resistivity, a change in conductivity, a change
- 3       in capacitance, a change in conductivity, and combinations thereof.
- 1       7. The hydrogen sensor of claim 1, wherein the Ag content ranges from about 0
- 2       percent to about 26 percent.
- 1       8. The hydrogen sensor of claim 1, wherein multiple metal nanowires within said
- 2       sensor comprise varying compositions so as to enable the detection of a range of
- 3       hydrogen concentrations over a range of temperatures.

- 1       9. The hydrogen sensor of claim 1, wherein said sensor provides for detection of  
2       hydrogen in transformers.

- 1       10. A hydrogen sensor comprising:
- 2           a) a dielectric surface material; and
- 3           b) one or more columns of metal nanoparticles on said surface, wherein
- 4               nanogaps between the nanoparticles close when exposed to a threshold
- 5               hydrogen concentration.
- 1       11. The hydrogen sensor of claim 10, wherein closure of said nanogaps effects a
- 2           detectable electronic response along the column of nanoparticles when said
- 3           column is incorporated into an electrical circuit.
- 1       12. The hydrogen sensor of claim 11, wherein said electrical response is selected
- 2           from the group consisting of a change in resistivity, a change in conductivity, a
- 3           change in capacitance, a change in conductivity, and combinations thereof.
- 1       13. The hydrogen sensor of claim 11, wherein said metal nanoparticles comprise Pd.
- 1       14. The hydrogen sensor of claim 11, wherein said metal nanoparticles comprise
- 2           alloys of Pd and Ag.
- 1       15. The hydrogen sensor of claim 14, wherein multiple columns of metal
- 2           nanoparticles comprise varying ratios of Pd and Ag so as to effect the detection of
- 3           hydrogen over a range of concentrations with the same device.
- 1       16. The hydrogen sensor of claim 11, wherein said sensor provides for detection of
- 2           hydrogen in transformers.

1 17. A method comprising the steps of:

2 a) forming at least one precisely-defined metal-alloy nanowire comprising  
3 nanobreakjunctions which close when exposed to predefined threshold  
4 concentrations of hydrogen;

5 b) forming a circuit comprising said nanowire; and

6 c) monitoring an electrical property within said circuit so as to determine when  
7 said nanobreakjunctions close.

1 18. The method of claim 17, wherein the nanowire comprises Pd and Ag.

1 19. The method of claim 17, wherein the metal nanowires have a composition that  
2 can be tailored so as to effect nanobreakjunction closure at varying concentrations  
3 of hydrogen.

1 20. The method of claim 17, wherein said method provides for hydrogen detection in  
2 transformers.